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PRESAYAN (IRKUTSK OBLAST)

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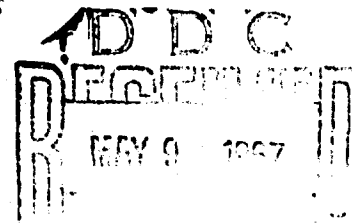
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EPIDEMIOLOGICAL CHARACTERISTICS OF A FOCUS OF TICK-BORNE ENCEPHALITIS IN
PRESAYAN (IRKUTSK OBLAST)

[Following is the translation of an article by M. V. Arkhangelskaya and A. S. Gelfand, Irkutsk Institute of Epidemiology and Microbiology, published in the Russian-language periodical Zhurnal Mikrobiologii Epidemiologii i Immunobiologii (Journal of Microbiology, Epidemiology and Immunobiology), No 9, 1965, pages 96--100. It was submitted on 4 Mar 1964. Translation performed by Sp/7 Charles T. Ostertag, Jr.]

According to the arrangement of the natural-historical regionalization of Irkutskaya Oblast, the territory which was subjected to study belonged to the Eastern Sayanskiy Rayon. This included all the southwestern margin of the oblast -- the mountain and foothill areas of the administrative rayons adjoining the main railroad line (Tayshetskiy, Nizhne-Udinskiy, Tulunskiy, Ziminskiy, Zalarinskiy, Cheremkhovskiy, Usolskiy, and partially Irkutskiy Rayons). The average annual temperature here did not exceed $-3-4^{\circ}$; the average amount of precipitation fluctuated within the limits of 550--650 mm (Arkhangelskaya and Florensova, 1962).

Forestry enterprises (Chemical-lumbering trusts and lumbering establishments), which are concentrated over a wide stretch of the deciduous-pine forests of Presayan, conditioned the close contact of the population with the forest. This circumstance was one of the main factors which contributed to the rise in the incidence of tick-borne encephalitis; from year to year a large portion of the incidence in the oblast belongs to the population of regions with the described landscape.

The materials of a six-year (1957--1962) zoologo-parasitological and virological investigation, carried out by personnel from the Institute's Department of Naturally Focal Infections in the Nizhneudinskiy and then the Cheremkhovskiy Rayons, made it possible to characterize the natural focus of tick-borne encephalitis in Presayan by the following main conditions: a) the vector of tick-borne encephalitis for the forest zone is the tick *Ixodes persulcatus* P. Sch.; b) the average number of forest ticks in nature was relatively low and fluctuated from 7.2 (1961) to 16.2 (1962) specimens per 1 km of itinerary; c) the distribution of ticks in natural habitats was not uniform, there were sectors of increased numbers -- from 10 to 25.8 (mixed deciduous forests), and of reduced numbers -- from 1.8 to 9.6 (dark coniferous forests); d) among the mammals the main sources of nourishment for the preimago stages of the forest tick in nature were the chipmunk, squirrel, mountain hare, the northern red-backed and large-toothed red-backed voles and shrews of the genus *Sorex*, and among the birds there were representatives of 23 species; the main sources of nourishment for adult ticks were the mountain hare and the roe deer; e) in different years the average level of virus carrying among forest ticks comprised from 4.2 (1961) up to 8% (1960).

As regards the epidemiological characteristics of tick-borne encephalitis in the Irkutskaya Oblast, up until recently special investigations in this area have hardly been carried out.

According to statistical data, the specific proportion of workers from the lumbering industry among the total number infected with tick-borne encephalitis throughout the Irkutskaya Oblast comprised about 70%. On this basis tick-borne encephalitis is classified as an occupational illness and stemming from this all the necessary prophylactic measures are put into practice.

Earlier, on the basis of the results of serological investigations, we (Arkhangelskaya and Folrensova, 1962) made the proposal concerning the decisive importance of the everyday living factor of the inhabitants of the taiga zone of Presayan in the contact with the natural focus. The present work cites additional material which supports this proposal.

During the period 1959--1962 epidemiological observations were carried out in 3 different landscapes of the Cheremkhovskiy Rayon -- steppe, forest-steppe, and taiga. It was established that the degree of contact of the population of the different landscapes with the natural focus of tick-borne encephalitis was intimately connected with the nature of their economic activity and living conditions.

The interrelationships of the population with the natural focus of tick-borne encephalitis were especially complex in the taiga sector of the focus (the belt of deciduous--pine forests). The main occupations of the population here were the felling of trees and the extraction of soft resin. This contributed to the intimate industrial contact of the population with the forest. The completely different nature of the industry in these two branches of forestry made an impression on the conditions for contact with the natural focus of infection on the part of the residents in the settlements for the chemical-lumbering trusts and the lumbering establishments.

As a rule the settlements for the lumbering establishments were located in a river valley (at sites which were suitable for floating lumber), among forest plantings of a mixed type, which were thinned out in the immediate vicinity of the living quarters with cleared spaces of different antiquity. Preparation of the lumber is carried on throughout the entire year with the same intensity, and in connection with this the numerical constitution of the workers during the year is relatively stable; the majority of the work at the lumbering establishments is mechanized.

A detailed acquaintance with the working and living conditions of the workers and members of their families for the purpose of clearing up the manner and degree of their contact with the vector of tick-borne encephalitis showed that at the sites for the direct execution of lumbering operations (felling of trees), the infestation of the workers with ticks took place comparatively rarely. This is explained to a significant degree by the fact that felling is usually carried out on the dry sunny slopes of mountains, where the number of forest ticks is generally not

high. Besides this, the extensive use of equipment and the constant stay of large contingents of people in the forest led to a disruption of the natural structure of the natural focus, which furthered the disappearance of the main source of nourishment for adult ticks and a significant change in respect to the species composition of the source of nourishment for their preimago stages. It is also necessary to take into consideration the harmful effect of the fuel and lubricating substances with which the clothing of the workers is usually impregnated.

This was supported by the results of a direct count of tick attacks on 30 workers during the course of the working day on 7, 8, and 10 Jun, 1961 at the site of industrial operations (Ugly sector). Infestation by ticks was established in only 3 cases, though their number in nature at this time was sufficiently high (up to 50 specimens per 1 km of course in a similar habitat of untouched forest). Encounters with ticks took place considerably more often during visits to the forest for purposes of various household tasks (collecting long-rooted onions, hunting, fishing). Usually these were sectors of mixed coniferous-deciduous or deciduous forest with a well expressed seedling growth and luxurious herbage. Here the number of ticks attacking a man in some cases reached 40--50 specimens in the course of a day.

For the purpose of clearing up which contingent was the most threatened in respect to the possibility of infection with tick-borne encephalitis, a comparative calculation was made of the duration of stay in the forest of the 3 main groups of the population in the lumber settlements and the frequency of tick infestation on them.

These groups included the workers in the lumbering establishment, students and "others," that is, housewives and persons whose activity was not connected with staying in the forest. The calculation was carried out for a period of a month (1 Jun -- 1 Jul, 1962) at 3 populated points -- Novostroyka, Gorodok and Saklir -- by means of weekly regular rounds and interrogations of the residents.

We converted the summary data obtained into indices, that is, average indices for one man. It can be seen from table 1 that although the index for the duration of stay in the forest among the representatives of the main professional group exceeded the index for the group of students by 20 times and the index for the group of "others" by 30 times, the indices of infestations and attachment by the ticks was hardly any different in these 3 groups.

This makes it possible to consider that for the residents of lumbering settlements the contact with the natural focus of infection was determined by the everyday living factor, which was extended to an equal degree to all the groups of the population.

In the enterprises for the chemical-lumbering trusts the conditions of contact of the residents with the natural focus were somewhat different. The onset of the industrial season (extraction of soft resin) coincided with the periods of an increase of the seasonal activity of Ixodes ticks in nature. At this time a large number of seasonal workers are attracted to the forest. These workers come from a nonimmune population living

beyond the limits of the endemic territory. In the summer period members of the workers' families also take part in collecting soft resin, that is, they come into intimate industrial contact with the forest. Production characteristics in the chemical-lumbering trusts conditioned the intensive contact of the workers with the vectors of tick-borne encephalitis throughout the entire working day. While performing the work of tapping and gathering the resin the workers cover up to 30--35 km a day in the taiga. During this time they cross various types of forests, including impregnations of small aspen groves in the forest tract which are teeming with ticks. Besides this frequent encounters with the vector took place when the workers were resting. For this purpose they usually select shaded cool places along the banks of streams; an increased concentration of ticks are noted in such sectors.

The forest which approached close to the populated points was a place for the constant visits of the residents, including children; cattle pastured close to the living quarters. The number of ticks around populated points was high.

A recording of the frequency of infestation by ticks, conducted by questioning 142 residents of Melgity during June of 1961, showed that the entire population of this settlement was subjected to infestation and attachment by ticks regardless of their professional affiliation. As a result of a direct count, performed on 22 workers of a chemical-lumbering trust during the working period for 3 days (6, 7 and 8 June, 1961), it was established that they were all subjected to infestation with ticks. The number of ticks removed was from 1 to 13, with an average of 3 ticks from one worker in one day.

Attachment of the ticks was often observed by persons who had not gone beyond the confines of the settlement. In these cases it was established that the ticks were brought in by farm animals and dogs.

These observations confirmed that in the settlements belonging to the chemical-lumbering trusts the industrial contact of the residents with the natural focus of tick-borne encephalitis was much more intensive than in settlements belonging to lumbering enterprises. However, the peculiarities of production and living conditions did not permit the drawing of a clear margin between the degree of this contact for the various groups of the population.

The all-round contact with the natural focus of infection by the inhabitants of the taiga landscape of Presayan was also expressed in the results of the serological investigations of 1124 men, which we carried out over a period of 3 years (1960--1962). The sera were investigated in the complement fixation reaction (in the modification of Smorodintsev), and in 1962 also in the hemagglutination inhibition reaction. According to our data the sensitivity of the latter reaction was approximately 50% higher. The general percentage of positive results in the complement fixation reaction fluctuated from 5.8 (1961) up to 25 (1960). No significant difference was noted in the value of this index for the various age and professional groups of the population. This testified to the similar

frequency of contact with the causative agent of tick-borne encephalitis.

In this manner, the results of the epidemiological observations and the serological investigations indicated that in the contact of the inhabitants of Presayan with the natural focus of tick-borne encephalitis, the leading role was played by the everyday living and not the industrial factor. Here it is appropriate to ask the question: In such a case how is it possible to explain the "professional" nature of incidence with tick-borne encephalitis in the Irkutskaya Oblast? Our observations made it possible to establish that the greatest number of cases occurred in that nonimmune contingent which was made up of workers in the chemical-lumbering trusts who lived outside of the endemic territory. In analyzing 91 cases of the disease we established that in 61 men it set in prior to the lapse of a three-year period of residence in the territory of the natural focus, and 43 of these had tick-borne encephalitis during the first season of work. Analogous cases, which make up a considerable figure throughout the oblast as a whole, give the appearance of a professional nature to the disease.

There was special interest in resolving the problem concerning the dependency between the degree of intensity of the natural focus of the disease in various years and the frequency of infection of the population. As the main test we used the seasonal immunological shifts in the blood of the population (based on the complement fixation reaction). For this we investigated paired sera, taken prior to the onset and upon conclusion of the epidemic season in 1961 and 1962. We also took into consideration the results of investigating the sera from a single collection at the end of the epidemic season.

By using table 2 to compare the serological indices for 3 years with the level of the number and virus carrying ability of *I. persulcatus* ticks in nature, it is not difficult to notice the presence of a direct dependency between the values of these indices in 1960 and 1961. In 1962 this dependency was manifested only in respect to the number of ticks. However, here it is necessary to take into consideration the increase in the number of virus carrying ticks in nature due to the increase in the overall number of ticks.

Conclusions

1. The following peculiarities were exposed in the contact of the population with the natural focus of tick-borne encephalitis in the territory of the forest belt of Presayan: For the population of settlements belonging to lumbering enterprises the daily living factor ~~had~~ at the basis of this contact; for the population of settlements belonging to the chemical-lumbering trusts the industrial factor played a significant role; however, its significance was spread to all the groups of the population, which specified the approximately similar conditions of contact with the focus for the entire population.

2. It is expedient to differentiate the system of prophylactic measures in respect to the inhabitants of populated points of different types: For the settlements belonging to the chemical-lumbering trusts they should include the compulsory general vaccination of the population

and the creation of tick-free zones around the populated points; for residents of the settlements belonging to lumbering establishments, along with the mass immunization of the population it is necessary to carry out tick exterminating measures at the sites which are most frequently visited by the inhabitants in the performance of their everyday tasks.

3. A correlation was revealed between immunological indices (based on the complement fixation reaction) and the zoo-parasitological indices of the intensity of the natural focus (numerical strength and virus carrying ability of the ticks in nature) in various years.

Literature

1. Arkhangel'skaya, M. V., Atlas of the Irkutskaya Oblast, Moscow--Irkutsk, 1962, p 1.
2. Florensova, V. A., Trudy of the Irkutsk Scientific-Research Institute of Epidemiology and Microbiology, 1962, No 7, p 37.
3. Shotskiy, V. P., Natural Conditions of Agricultural Economy and the Natural-Historical Regions of the Irkutskaya Oblast, Irkutsk, 1956, p 115.

Table 1

Indices of the frequency of contact of the population of settlements belonging to lumbering enterprises with the vector of tick-borne encephalitis.

Group	Frequency of visiting the forest (in hours per 100 men for a month)	Index	Number of cases of infection by ticks	Index	Number of cases of attachment by ticks	Index
Workers	14,890	149	308	3	41	0.4
Students	669	6.7	183	1.8	45	0.4
Others	435	4.4	284	2.8	90	0.9

Table 2

Seasonal immunological shifts in the blood of the population and farm animals and the indices of intensity of the focus.

Year	Paired sera investigated	Seasonal rise of antibodies		% positive reactions at end of epidemic season	Average number of Ixodes ticks			Average % of virus carrying ticks in nature
		abs.	%		in nature	on agricultural animals encountered	abundant	
1960	From people	Not investigated		25.8	15.6	46	2.5	8
	From farm animals	Not investigated		21.3				
1961	From people - 256	15	5.8	5.8				
	From farm animals - 125	14	11.2	12.5	7.2	38	1	4.2
1962	From people - 378	64	16.9	18.5				
	From farm animals - 120	26	21.6	22.9	16.2	38	1.2	4.4